

Florida EPA Phosphate Mine Survey Comparison of Aerial and Ground Survey Options

Background

Abandoned Phosphate Mine Environment – Observations from a site visit and imagery

1. Historical Site Assessment (HSA) information indicates that the elapsed time from previous mining operations to current land use is at least 30 years for all sites. The natural re-vegetation of the sites has obscured most man-made features except for the spoil mounds. The mounds are identified through process knowledge of the mining techniques used because most are heavily vegetated.
2. Water features including lakes, ponds, swamp areas and man-made canals vary from approximately 10-25% of the total land area within each CERCLA boundary provided.
3. Heavy vegetation areas that include mature trees and tangled undergrowth vary from approximately 15-35% of the total land area within each CERCLA boundary provided.
4. Open areas that may be driven by the RSL Kiwi vehicle or an ATV-mounted system vary approximately 30-60% of the sites. Some of the open areas may be parks, golf courses, residential areas or cattle grazing areas with limited access.
5. Open areas between trees or shrubs comprise approximately 15% of the sites. These areas could be accessible by a walking survey only using a backpack-type gamma detection system.

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Guidance

Scoping Surveys

Dependent on the progress of the HSA and initial radiological measurements conducted by the EPA, scoping surveys may be used to meet specific objectives including:

1. Providing data for the site prioritization scoring process.
2. Providing data for the characterization survey design.
3. Supporting the classification of portions of each site as a Class 3 area for planning a final status survey.
4. Obtaining an estimate of the variability of the residual contamination for each site.
5. Identifying non-impacted areas that may be appropriate for reference areas where the radionuclides of interest are in the terrestrial background.

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MARSSIM recommends that scoping surveys for gamma emitting nuclides approach a 100% area scan criteria based on the effective footprint of the instrumentation being used. The manual does not specify the range of footprint areas acceptable for the initial measurements. In addition, the manual recommends a limited number of surface scans, direct measurements and samples within the zones showing the highest impact.

Characterization Surveys

The characterization survey is planned based on the HSA and scoping survey results. It is the most comprehensive survey type and generates the most data. The primary objectives include:

1. Determine the nature and extent of the contamination.
2. Provide data to evaluate remedial actions and technologies.
3. Evaluate whether the survey plan can be optimized for the final status survey.
4. Support Remedial Investigation/Feasibility Study requirements.
5. Provide input to the final status survey design.

Survey Unit Areas

The MARSSIM suggests the following survey unit sizes for contaminated land areas:

1. Class 1 – Up to 2,000 m² (.5 acres)
2. Class 2 – 2,000 to 10,000 m² (.5 to 2.5 acres)
3. Class 3 – 10,000 m² to no limit (>2.5 acres)

Spatial Considerations

Helicopter:

At the planned 150-foot (46-meter) altitude for the RSL helicopter detector system the effective footprint will be 300 feet (92-meters) in diameter. The footprint area will be approximately 6544 m² (1.62 acres) recorded in one second intervals. With a forward speed of approximately 120 feet per second (70 knots) and line spacing of 250 feet, the effective footprint may be reduced to approximately 1.5 acres for most measurements. For ground depositions measuring from 10 to 100 feet in diameter surrounded by background activity, the helicopter cannot distinguish this width range. Any “hot spot” deposition of this size appears to be a point source after post flight data analysis. The multiplier to obtain the actual ground activity exposure rate to the aerial estimate will vary from a factor of ten for the 100-foot diameter “hot spot” to a factor of 900 for a “hot spot” of 10 foot diameter.

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Kiwi:

The detector height for the Kiwi vehicle will be 3-feet (1 meter) during the surveys. At an average forward speed of 2 meters/second and an effective detector width of 3 meters, the total footprint for the Kiwi is approximately 6 m² per second. If any “hot spots” measuring from 10 to 100 feet in diameter are within the survey area, the Kiwi data will convert to an actual exposure rate without the need for a multiplier correction factor. The ability for the vehicle to conduct adjacent line spacing to achieve 100% gamma scan coverage is heavily dependent on terrain, vegetation, structures and water features. Based on the ground conditions observed during the site visit, the Kiwi may only complete a gamma scan approximating 50% of the total site area due to the large areas of water and heavy vegetation.

ATV or Backpack Surveys:

The ATV and/or two ground backpack team's options would be used in conjunction with the Kiwi vehicle to obtain data in areas inaccessible to the larger vehicle. An ATV and backpack effort may add an additional 10-15% of gamma scan data at each site in support of the Kiwi surveys. Standard ground-based measurements are taken at 3 feet (1-meter) above ground level. With a forward speed that averages 1 meter per second, the detector footprint is about 6 feet (1.6 meters) in diameter.

Table 1. Scoping and Characterization Surveys
Comparison of Aerial, Kiwi and Ground Systems

Survey System	Gamma Scan Coverage	Area Surveyed per Day	Class 1 Survey Unit Coverage	Class 2 Survey Unit Coverage	Class 3 Survey Unit Coverage
Helicopter	95-100%	5 square miles	No	Partial	Yes
Kiwi	< 50%	.04 square miles	Yes	Yes	Yes
ATV or Backpack	< 15% (used with Kiwi)	.03 square miles	Yes	Yes	Yes

Table 2. Relative Safety Hazard Comparisons of Aerial, Kiwi and Ground Systems

Survey System	Weather	Towers and Trees	Snakes, Insects, Animals	Slip, Trip and Fall
Helicopter	Medium	High	Low	Low
Kiwi	Medium	Low	Medium	Medium
ATV or Bkpack	Medium	Low	High	High

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Conclusions

Based on the current data provided and observations from the site visit, the project should conduct a scoping survey to provide gamma scan coverage approaching 100% and to delineate the nature and extent of contamination within each site.

The RSL helicopter is the only survey system available that can achieve both objectives. Based on the areas of the four mine sites provided by the customer (~63 square miles), the helicopter would require approximately 32 hours of survey time to complete the scoping surveys of the Coronet, Tenoroc, Sydney and W.R. Grace/Bonnie Lake mines and surrounding mine areas.

Assuming that 30 square miles (50% coverage) of the four sites are available to the Kiwi systems, the time (and cost) required would be approximately 750 survey days. In addition, assuming 6.3 square miles (15% coverage) of the four mine sites are available to the ATV and/or backpack ground teams, the time (and cost) required would be approximately 320 days.

The selection of the helicopter would present quicker data results, less intrusive to the public, safer and less hazardous to complete for the survey personnel involved.

FY11 Forecasted Estimates

Kiwi Ground Survey (750 days)

- 50% Coverage of Four Mines and Surrounding Areas: \$9,000,000.

ATV/Backpack Ground Survey Teams (320 days)

- 15% Coverage of Four Mines and Surrounding Areas: \$3,840,000

Aerial (Helicopter) Survey (15 days)

- 100% Coverage of Four Mines and Surrounding Areas Individually: \$850,000
- 100% Coverage of Four Mines and Surrounding Areas Collectively: \$600,000